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(54) **Substrate-limited doughs.**

(57) A dough for the preparation of yeast-leavened flour products is provided whereby the dough comprises yeast and an amount of sugar(s) fermentable by the yeast and wherein the maximal amount of CO<sub>2</sub> gas produced during the proof is controlled and limited by the amount of fermentable sugar(s) present in the dough.

**EP 0 442 575 A1**

## SUBSTRATE-LIMITED DOUGHS

The present invention relates to doughs producing a limited and controllable volume of CO<sub>2</sub> gas during the proof period of the bread making process. Doughs used for bread making contain levels of fermentable sugar which are much higher than needed for producing the required volume of CO<sub>2</sub> gas during the final proof of a bread making process. Since both underproofing and overproofing of doughs will result in inferior bread quality (Pylar: Baking Science and Technology, Siebel Publishing company, 1973) it is important to strictly control all the variables which affect the rate of gas production in dough.

The current bread making processes show little tolerance towards small changes in process variables such as proof time, proof temperature and yeast dosage, which affect the rate of gas production during proofing. It is especially difficult to achieve constant gas production when bread is prepared from retarded doughs, which are proofed overnight by increasing the temperature of a cooled dough in a programmable cooling/proofing cabinet.

When frozen dough is used for bread making there are also serious disadvantages due to instability of the yeast during freezing, frozen storage and thawing (B.L. Bruinsma and J. Giesenschlag, Bakers Digest November 13, 1984 p. 6). A reduction in yeast activity causes a reduction in the volume of the baked bread. The proof time therefore has to be increased in order to correct for such a reduction in yeast activity. The necessary adjustment will vary from case to case depending on factors such as freezing rate, frozen storage time and thawing rate. For the baker this variation in the adjustment required is undesirable. Another disadvantage of the frozen dough method is that fast warming up of the dough will cause temperature gradients in the dough, leading to local overproofing of the outside part of the dough piece. This undesirable situation will occur in particular in large dough pieces even when the period of proofing is preceded by an overnight thawing period in a refrigerator (2-4 °C). Since temperature gradients due to a fast warming up have to be avoided during proofing of frozen doughs, long proof times are required even when higher amounts of yeast are used.

The present invention provides a dough for the preparation of a yeast-leavened flour product which comprises yeast and sugar(s) fermentable by the yeast, wherein the amount of sugar(s) fermentable by the yeast is limited so that the maximal gas production by the yeast is controlled. The invention also provides a method for producing a dough comprising yeast and sugar(s), which method comprises limiting the amount of sugar(s) fermentable by the yeast so as to control the maximal gas production by the yeast. In one embodiment the method of the invention includes carrying out a prefermentation step on a substantial part of the flour to reduce the amount of fermentable sugar in the dough. The yeast is allowed to consume substantially all available fermentable sugar(s) during the fermentation period of the bread making process. Once this amount of sugar has been consumed, sufficient CO<sub>2</sub> gas will have been produced to fully proof the dough. The dough volume will not substantially increase upon further extending the proof time. The quality of bread obtained from such doughs shows great tolerance towards large variations in factors determining the gas production rate in normal doughs such as dough temperature, yeast dosage or proof time.

Dough according to the present invention may be industrially prepared by methods similar to those used for the preparation of doughs containing conventional ingredients. The dough may be used for the preparation of various lean or rich breads and other farinaceous products which are optionally stored in the frozen state. The dough of the present invention may be used in a conventional manner, and may be baked after purchase, if necessary after thawing.

Yeast which is used in dough exists in several formulations such as cream yeast, compressed yeast or fresh yeast and dried yeast. Dried yeast is available as active dry yeast (ADY) and as instant dry yeast (IDY) having a moisture contents of 6-8% and 3-6% respectively. The yeast used in the present invention may, for example, conveniently be added to the flour in an amount up to 3% dry matter (w/w). Percentages (w/w) are calculated on the weight of the flour (100%). Suitably yeasts selected from the genera *Saccharomyces* and *Kluyveromyces* are used in the present invention. Advantageously a strain is used selected from *S. cerevisiae*, *S. unisporus*, *S. diarensis*, *S. exiguus* and *S. kluyveri*.

A dough according to the present invention suitably contains 1-3% (w/w) of fermentable sugar, allowing a total maximal gas production of 150-500 ml CO<sub>2</sub> per 100 g of dough.

'Fermentable sugar(s)' as used herein means sugars which may be fermented by the yeast and which may be present in the dough, may be added to the dough or may originate from carbohydrate fractions present in or added to the dough, which are converted during the bread making process into fermentable sugar(s) by enzymes present in or added to the dough.

The flour used in conventional doughs contains about 5% (w/w) of damaged starch, which is

convertable by the action of  $\alpha$  and  $\beta$ -amylases starch into maltose. If the formed maltose (in a lean dough) is completely fermented by the yeast about 1000 ml of CO<sub>2</sub> gas will be produced in 100 g of dough. This amount is about 5 times as much as is required to obtain a desirable proof height and consequently an optimal loaf volume after baking. Advantageously wheat flour and/or rye flour is used.

5 According to one embodiment of the invention a flour is used with a level of less than 2%, preferably 0.1-1%, more preferably 0.1-0.5% (w/w) of damaged starch. This flour allows a maximal gas production of about 200 ml CO<sub>2</sub> per 100 g dough, originating from the glucofructosan fraction and the reduced amount of damaged starch.

10 Another way of reducing the amount of fermentable sugar available is the application of a sponge and dough process, in which the yeast ferments the fermentable sugar in the bulk of the flour at the sponge stage. Subsequently the remainder of the flour is added and mixed into a dough containing a reduced and limited amount of fermentable sugar. This sponge and dough process can advantageously be applied with regular bakers yeast to control the amount of fermentable maltose in the dough.

15 In one embodiment of the invention the dough comprises a yeast which is not capable of fermenting part of the sugars present in the dough, typically maltose or maltose and sucrose. When the yeast is incapable of fermenting maltose, the maltose originating from the damaged starch fraction of the flour cannot be used by the yeast for the CO<sub>2</sub> production. The amount of gas produced is controlled by fermentation of other sugars present (mainly glucofructosans), or added to the dough.

20 According to another aspect of the invention the dough comprises added carbohydrate as the only source of sugar(s) that can be fermented by the yeast.

An advantage of the invention is that it allows the volume of a baked product to be chosen in advance and achieved by controlling the (maximal) gas production. Once all fermentable sugars in the dough have been fermented and have produced the desired volume of CO<sub>2</sub> required for fully proofing the dough, the proof time may be extended without causing serious overproofing of the dough. Such doughs provide great flexibility during bread making since the fully proofed doughs can be kept for a considerable length of time in a proofing cabinet before being baked into bread. Moreover the (maximal) amount of CO<sub>2</sub> produced in such dough depends only on the amount of fermentable sugars present in or added to the dough and is hardly influenced by factors controlling the rate of gas production such as yeast dosage or dough temperature.

30 Another advantage of the invention is that the sweet taste of the baked product can be controlled. Since the entire amount of fermentable sugars present in the dough will, according to the invention, be consumed by the yeast, non fermentable sugars can be used for adjusting the sweetness of the baked product. When, for example, a maltase and invertase deficient yeast is applied, saccharose, maltose and glucofructosans in the dough are not fermented and will contribute to the sweetness of the bread product. When regular bakers yeast is used, artificial sweeteners and non fermentable sweet sugars can be added to improve and adjust the sweetness of the baked product. Examples of useful additives for controlling sweetness are artificial sweeteners like aspartame (NutraSweet™), lactose (or whey permeate) and isomaltulose (Palatin™). Generally 0.1-10% of such non-fermentable sugars will be present in or may be added to the dough.

40 In one embodiment, the method of the invention includes the step of freezing the dough. As an example, the method may comprise the steps of

- (a) dividing the unfrozen dough into separate portions of dough,
- (b) moulding each portion of dough into the desired shape and
- (c) freezing each portion of the dough to a temperature of -30 °C to -10 °C.

45 Frozen doughs produced in accordance with the invention have additional advantages. First of all a reduction in the yeast activity due to a freeze/thaw cycle will no longer affect the volume of the baked product, provided that sufficient time has been given to the (residual) yeast for a complete conversion of all fermentable sugars in the dough into CO<sub>2</sub> gas. Moreover the conventional method of critical overnight thawing at 2-4 °C followed by proofing at 30-40 °C, can be replaced by a flexible overnight thawing/proofing method at ambient temperature (20-30 °C). By using this method the baker will have fully proofed doughs at his disposal early in the morning and these doughs can be baked into bread products of constant quality at any moment during the rest of the day. It is also possible to obtain fully proofed substrate-limited doughs directly from frozen doughs by using a rapid thawing/proofing method, which is not applicable to normal doughs.

55 Another embodiment of the method of the invention therefore comprises combining the steps of thawing and proofing in one step by bringing the frozen dough to a temperature of 20 °C to 50 °C. When normal doughs are rapidly thawed and proofed, temperature gradients will occur, resulting in a local overproofing of the outside part of the dough pieces. This undesirable situation is prevented when using substrate-limited

doughs according to the present invention, even when large dough pieces are rapidly thawed and proofed. Also the period of time for the thawing and especially for the proofing is now not critical anymore because the gas production will stop when all the fermentable sugars are converted. Because in this method the volume of CO<sub>2</sub> gas produced depends on a limited amount of fermentable sugar in the dough, the frozen dough method is very flexible and is suited for the home baked goods market.

One embodiment of the method of the invention involves the steps of

- (a) thawing the frozen dough at a temperature of 2 °C to 50 °C,
- (b) proofing the dough for at least 40 minutes at a temperature of 20 °C to 50 °C, and
- (c) baking the dough.

Another advantage is that the frozen doughs can be thawed and proofed in large numbers at the same time, whereas the fully proofed doughs can be stored and baked later on in smaller quantities at any moment during the rest of the day. In this way it is possible to sell all day long freshly baked goods.

This advantage also applies for fresh doughs which are prepared early in the morning and which can be baked at any moment during the rest of the day as the volume of the fully proofed dough will not substantially increase during the rest of the day.

The present invention may also be used in connection with the retarded dough method. Retarded doughs are applied by some bakers to avoid night work. According to the retarded dough method, cooled doughs are proofed during the night in a programmable cooling, proofing room. The next morning the doughs are ready for baking and fresh bread is therefore available early in the morning. According to the present invention the production of CO<sub>2</sub> gas can be controlled by limiting the amount of fermentable sugar instead of controlling the temperature and time. Moreover the doughs can be stored and baked afterwards at any moment during the rest of the day.

The present invention is useful not only for bread making but also for preparing all kinds of yeast leavened bakery products such as pizzas, croissants and doughnuts.

In the following examples there are described several preferred embodiments to illustrate the invention. However, it is to be understood that the invention is not intended to be limited to the specific embodiments.

#### Example 1

The flour (Apollo) used in the next Examples (1, 2, 4-8) was obtained from Stolp & Co., Bunschoten, The Netherlands. This American type of flour has been bromated at the mill. Bromate, present in the flour together with ascorbic acid, added to the flour contribute to the stability of the doughs when being subjected to long fermentation periods. Gasproduction, however, is not affected by these oxidants. Table 1 shows how the various carbohydrate fractions contribute to the gasproduction in doughs prepared from Apollo flour.

Table 1

5	% in flour	fraction	ml CO <sub>2</sub> / 100 g dough
10	0.15	glucose	25
15	1	glucofructosans	155
		invertase —>	glucose + fructose
20	5	damaged starch	maltose 780
25		$\alpha + \beta$ amylase —>	total: 960

During the final proof of the bread making process only about 200 ml CO<sub>2</sub>/100 g dough are required to fully proof a dough. When conventional baker's yeast is used, about 5 times as much gas is formed as is necessary (see Table 1: 960 ml CO<sub>2</sub>/100 g dough). Using the same dough a smaller amount of gas can be produced by choosing a yeast which ferments only the glucose and fructose and which is not capable of fermenting maltose.

A dough formulation was prepared of the following composition

Formulation

	Flour (Apollo)	100%
5	Water	56%
	Instant dry yeast ( <i>S. cerevisiae</i> V 328 CBS 108.90)	2%
	Salt	2%

10

Procedure

	Mixing time	6 minutes at 52 r.p.m. (pin mixer)
	Dough temperature	30°C
15	Scaling weights	50 g dough piece
	Gassing power measurement:	30°C

20 Result

	Hours	total ml	ml/h
25	0	0	0
	0.5	20	40
	1.5	120	100
30	3	150	20
	6	200	17
	12	250	8
35	18	300	8
	24	350	8

The yeast strain used for this experiment is a maltose adaptive ( $MAL^{+/}$ ) instant dry yeast strain, which will  
 40 behave as a  $MAL^{-}$  strain ( $MAL^{-}$  = not fermenting maltose), when added in dosages above 1.5% to flour. When added in a dosage of 2% (w/w) about 120 ml  $CO_2$  gas was produced mainly from the glucofructosan fraction within 1.5 hours at 30°C. Thereafter the gas production rate drops sharply and only about 8 ml  $CO_2$  was produced per hour in a 50 g dough piece.

In gassing power tests similar results were obtained when replacing the 2% *S. cerevisiae* V328 CBS  
 45 108.90 instant dry yeast ( $MAL^{+/}$  = maltose adaptive) by 2% compressed yeast of one of the following sucrose (= saccharose) fermenting and maltose non-fermenting ( $SUC^{+}/MAL^{-}$ ) yeast strains:

	<i>S. cerevisiae</i> D2	(CBS 109.90)
	<i>S. cerevisiae</i> DS 10638	(CBS 110.90)
	<i>S. cerevisiae</i> DS 16887	(CBS 111.90)
50	<i>S. cerevisiae</i> V 79	(CBS 7045)
	<i>S. cerevisiae</i> V 372	(CBS 7437)
	<i>S. exiguus</i> V 04	(CBS 112.90)
	<i>S. exiguus</i> 8130	(CBS 8130)
	<i>S. kluyveri</i> 4798	(CBS 4798)
55	<i>S. kluyveri</i> 6545	(CBS 6545)
	<i>S. kluyveri</i> 6626	(CBS 6626)

Example 2

Table 2 shows the results of gassing power tests with 100 g dough pieces containing 2% compressed yeast of a sucrose (= saccharose) and maltose non-fermenting yeast (SUC<sup>-</sup>/MAL<sup>-</sup>) strain S. unisporus 398 (CBS 398). From this Table it can be concluded that hardly any CO<sub>2</sub> gas is produced during fermentation (< 50 ml CO<sub>2</sub> / 100 g dough after 4 hours of fermentation). Addition of 1.1% readily fermentable glucose results in a rapid production of about 130 ml CO<sub>2</sub> gas within 2 hours of fermentation. Hereafter the CO<sub>2</sub> gas production drops sharply. Hardly any additional gas production is observed after the addition of 0.95% saccharose which cannot be fermented by this yeast strain. Therefore readily fermentable glucose (or fructose) can be applied for controlling the amount of gas produced, whereas non-fermentable saccharose can be applied for controlling sweetness of bakery products produced from these doughs. Similar results have been obtained using one of the following SUC<sup>-</sup>/MAL<sup>-</sup> strains:

<u>S. unisporus</u> 398	(CBS 398)
<u>S. diarensis</u> 4309	(CBS 4309)
<u>S. diarensis</u> 6463	(CBS 6463)
<u>S. cerevisiae</u> DS 16887	(CBS 111.90)

Table 2 strain *S. unisporus* 398 (CBS 398)

min	Dough		1.1% Dextrose		0.95% Saccharose	
	total mls	mls / 15 min	total mls	mls / 15 min	total mls	mls / 15 min
0	0.0	0.0	0.0	0.0	0.0	0.0
30	5.0	2.4	27.4	19.3	5.2	2.7
60	9.2	2.6	81.2	27.8	9.9	2.4
90	14.5	3.2	119.8	14.4	17.1	3.8
120	21.3	3.6	134.5	6.3	25.9	4.6
150	28.5	3.8	145.3	5.3	35.0	4.6
180	36.0	3.6	153.9	4.0	44.5	4.6
210	43.4	3.6	162.4	4.3	54.2	4.9
240	49.9	2.9	170.0	4.0	63.3	4.7

Example 3

For demonstrating the principle of the invention a model dough with a limited amount of fermentable sugar was prepared by mixing regular bakers yeast (SUC<sup>®</sup>/MAL<sup>®</sup>), gluten, starch and sugar into a dough.



Formulation

5	Native wheat starch (Roquette)	85%
	Gluten (Gluvital)	15%
	Xanthan gum (Keltrol F)	0.5%
	Glucose	1.2%
10	Salt	2%
	Shortening	0.5%
	Water	57%
15	Ascorbic acid	100 ppm
	Fungal $\alpha$ -amylase	
	P200 (Gist-brocades)	100 ppm
20	Grindamyl (Grinsted)	300 ppm
	NH <sub>4</sub> Cl	300 ppm
	NaH <sub>2</sub> PO <sub>4</sub> ·H <sub>2</sub> O	375 ppm
	Fermipan™	
25	(Instant dry yeast from Gist-brocades)	1% or 2%

Procedure

30	Mixing time	10 minutes, 52 r.p.m. (pin mixer)
	Dough temperature	28°C
35	Scaling weights	150 g (pup loaves)
	Bench time	20 minutes at room temperature
	Proof time	1, 2 or 3 hours at 30°C

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ResultsTable 3

	% Fermipan	Final proof time (hours)	Proof height (mm)	Loaf volume (ml)
5				
10	1	1	59	445
	1	2	90	527
	1	3	89	517
15	2	1	86	535
	2	2	92	529
	2	3	90	520
20				

From the results in Table 3 it can be concluded that the limited amount of fermentable sugar in these doughs is consumed within 1 hour when 2% Fermipan is used and within 2 hours when 1% Fermipan is used. The proof heights and loaf volumes are nearly constant and do not depend on proof time or yeast dosage once the fermentable sugars have been converted into CO<sub>2</sub> gas.

Example 4

A sponge and dough procedure can also be applied for reducing the amount of sugars fermentable by regular bakers yeast (SUC<sup>+</sup> MAL<sup>+</sup>).

FormulationSponge

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Flour	70%
Water	53%
10 Salt	2%
Fungal $\alpha$ -amylase P200 (Gist-brocades)	250 ppm
Koningsgist™ (compressed yeast from	
15 Gist-brocades)	5%

Dough

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Sponge containing	70% of flour
Shortening	0.5%
Ascorbic acid	100 ppm
25 Flour	30%

Procedure

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Sponge

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Mixing time	3 minutes 52 r.p.m. (pin mixer)
Dough temperature	28°C
Fermentation	3 hours at 30°C

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Dough

5	Mixing time	3 minutes 52 r.p.m. (pin mixer)
	Dough temperature	30°C
	Scaling weights	150 g (pup loaves)
	Bench time	20 minutes at room temperature
10	Proof time	1-3 hours at 30°C

Table 4

15	% Flour in Sponge	Proof time	Proof height	Loaf Volume
	%	(hours)	(mm)	(ml)
20	70	1	85	598
	70	1.5	85	570
	70	2	92	598
25	70	3	97	637

From Table 4 it can be concluded that within 1 hour proof time all fermentable sugars in the dough  
 30 have been converted into CO<sub>2</sub> gas. Proof heights and loaf volumes remain nearly constant when extending  
 the final proof time up to 3 hours.

Example 5

35 When using regular wheat flour containing about 5% of damaged starch a maltose non-fermenting yeast  
 strain (MAL<sup>-</sup>) can be applied for reducing the amount of CO<sub>2</sub> gas produced to the desired level.

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Formulation

5	Flour	100%
	Water	53%
	Salt	2%
	Fungal $\alpha$ -amylase P200 (Gist-brocades)	50 ppm
10	Shortening	0.5%
	Ascorbic acid	100 ppm
	Yeast	2% instant dry
15	<u>S. cerevisiae</u> V328 (CBS 108.90)	(MAL <sup>+</sup> /-)
		or
		2% compressed
20	<u>S. cerevisiae</u> D2 (CBS 109.90)	(SUC <sup>+</sup> /MAL <sup>-</sup> )
		or
		2% compressed
25	<u>S. cerevisiae</u> DS 16887 (CBS 111.90)	(SUC <sup>-</sup> /MAL <sup>-</sup> )
		or
		2% compressed
30	<u>S. cerevisiae</u> DS 16887 (CBS 111.90) + 1% glucose	

Procedure

35	Mixing time	6 minutes at 52 r.p.m. (pin mixer)
	Dough temperature	28°C
	Scaling weights	150 g (pup loaves)
	Bench time	30 minutes at room temperature
40	Proof time	70-340 minutes at 30°C

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Table 5

Leavener	Proof time (min)	Proof height (mm)	Loaf volume (ml)
2% instant dry yeast ( <u>S. cerevisiae</u> V 328 CBS 108.90)	70	60	486
2% instant dry yeast ( <u>S. cerevisiae</u> V 328 CBS 108.90)	170	71	519
2% instant dry yeast ( <u>S. cerevisiae</u> V 328 CBS 108.90)	220	70	508
2% instant dry yeast ( <u>S. cerevisiae</u> V 328 CBS 108.90)	290	75	494
2% instant dry yeast ( <u>S. cerevisiae</u> V 328 CBS 108.90)	340	75	497
2% compressed yeast ( <u>S. cerevisiae</u> D2 CBS 109.90)	170	67	490
2% compressed yeast ( <u>S. cerevisiae</u> D2 CBS 109.90)	255	70	504
2% compressed yeast ( <u>S. cerevisiae</u> D2 CBS 109.90)	340	73	495
2% compressed yeast ( <u>S. cerevisiae</u> DS 16887 CBS 111.90)	170	36	210
2% compressed yeast ( <u>S. cerevisiae</u> DS 16887 CBS 111.90)	255	39	225
2% compressed yeast ( <u>S. cerevisiae</u> DS 16887 CBS 111.90)	340	43	240
2% compressed yeast ( <u>S. cerevisiae</u> DS 16887 CBS 111.90) + 1% glucose	170	65	496
2% compressed yeast ( <u>S. cerevisiae</u> DS 16887 CBS 111.90) + 1% glucose	255	73	510
2% compressed yeast ( <u>S. cerevisiae</u> DS 16887 CBS 111.90) + 1% glucose	340	72	508

From the results given in Table 5 it can be concluded that variation in proof time from 170 to 340 minutes hardly influences proof heights and loaf volumes when using S. cerevisiae V 328 (CBS 108.90) ( $\text{SUC}^+/\text{MAL}^-$  at 2% dosage) or S. cerevisiae D2 (CBS 109.90) ( $\text{SUC}^+/\text{MAL}^-$ ). When using S. cerevisiae DS 16887 (CBS 111.90) ( $\text{SUC}^-/\text{mal}^-$ ) hardly any  $\text{CO}_2$  gas is produced resulting in a low loaf volume. When supplying this yeast strain with a readily fermentable sugar (1% glucose), proof heights and loaf volumes increase to normal levels and are hardly affected when extending the proof time from 170 to 340 minutes.

#### Example 6

A dough of the following composition was prepared, and stored in the refrigerator.

### Recipe

5	Flour	100%
	Water	53%
	Salt	2%
10	Instant dry yeast <i>S. cerevisiae</i> V 328 (CBS 108.90)	2%
	Fungal $\alpha$ -amylase P200 (Gist-brocades)	150 ppm
	Ascorbic acid	100 ppm

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### Procedure

	Mixing time	6 minutes at 52 r.p.m. (pin mixer)
20	Dough temperature	20°C
	Scaling weights	150 g (pup loaves)
	Bench time	30 minutes at room temperature
25	Proof time	1.5 hours at 30°C
	Cooling/storage	0-6 hours at 2-4°C (refrigerator)

30 The results of the baking tests in Table 6 show that low temperature doughs, which have been stored in the refrigerator for 0-6 hours, gave a constant proof height after proofing for 1.5 hours and a constant loaf volume after baking. Such a procedure allows a baker to prepare bread from doughs which have a long shelf life in the refrigerator, and can be baked into bread of constant quality after a proof time that is not very critical.

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Table 6

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	Storage time at 2-4°C	Proof height	Loaf volume
40	before proofing		
	(hours)	(mm)	(ml)
	0	68	469
45	1	72	493
	2	70	500
	4	75	496
50	6	78	510
=====			

### 55 Example 7

Frozen doughs of the following composition were prepared by the following procedure.

Recipe

	Flour	100%
5	Water	52%
	Salt	2%
	Instant dry yeast <i>S. cerevisiae</i> V 328 (CBS 108.90)	2%
10	Fungal $\alpha$ -amylase P200 (Gist-brocades)	150 ppm
	Ascorbic acid	100 ppm

Procedure

15	Mixing time	6 minutes at 52 r.p.m. (pin mixer)
	Dough temperature	20°C
20	Scaling weights	150 g (pup loaves)
	Bench time	30 minutes at room temperature
	Freezing	1 hour at -20°C
	Frozen storage	1 or 2 days at -20°C
25	Thawing / Proofing procedure I	overnight (18 hours) at 2-4°C + 1-3 hours at 30°C
30	Thawing /Proofing procedure II	0.5-3 hours at 40°C

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Table 7

Thawing / Proofing procedure	Proof height (mm)	Loaf volume (ml)
18 h at 2-4°C + 1 h at 40°C	67	483
18 h at 2-4°C + 1.5 h at 40°C	70	495
18 h at 2-4°C + 2 h at 40°C	75	509
18 h at 2-4°C + 3 h at 40°C	77	500
0.5 h at 40°C	40	250
1 h at 40°C	45	350
1.5 h at 40°C	65	490
2 h at 40°C	70	510
3 h at 40°C	77	500

The baking results in Table 7 indicate that a proof time extension from 1 to 3 hours at 30°C hardly affects loaf volume and proof heights of frozen doughs that have been thawed overnight in a refrigerator. When the overnight thawing step was omitted, a constant maximal proof height and loaf volume was attained after a proof time of about 1.5 hours. The rapid thawing/proofing procedure at elevated temperature (40°C) did not result in an irregular proofing of the doughs. Thus the local overproofing of the outside parts of the dough, which is caused by temperature gradients during thawing/proofing, can be avoided when using doughs containing a limited amount of fermentable substrate.

#### Example 8

Dough formulations of the following compositions were prepared.

Recipe	A	B	C
5 Flour (Apollo)	100%	100%	100%
Water	56%	56%	56%
Instant dry yeast <u>S. cerevisiae</u> V 328			
(CBS 108.90)	2%	2%	2%
10 Salt	2%	2%	2%
Lactose	-	3%	-
Ascorbic acid	100 ppm	150 ppm	100 ppm
15 Shortening (ADM)	1%	-	0.2%
Sodium stearoyl-2-lactylate	-	0.5%	0.3%
Fungal $\alpha$ -amylase P200 (Gist-brocades)	-	100 ppm	100 ppm
20 Grindamyl S100 (Grindsted Products)	-	300 ppm	300 ppm
Xanthan gum	-	0.5%	-

#### 25 Procedure

Mixing time	6 minutes at 52 r.p.m. (pin mixer)
Dough temperature	20°C
30 Scaling weights	525 g
Bench time	25 minutes at 28°C
Freezing	100 minutes at -35°C
35 Storage	1 day or 5 weeks at -20°C
Thawing / Proofing	
procedure I	19, 20, 21, 22, 23, 24, 25 hours at 25°C
40 Thawing /Proofing	
procedure II	19 hours (overnight) at 2-4°C followed by 3, 4, 5, 6 hours at 30°C

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Table 8 - Results

Thawing/proofing	Storage time (days at -20°C)	Proof height (mm)	Loaf Volume (ml)	Proof height (mm)	Loaf Volume (ml)
<b>Procedure I</b>					
<b>Composition A</b>					
19 h at 25°C (overnight)	1	83	1900	102	2250
20 h (+ 1 h)	1	87	1950	108	2250
21 h (+ 2 h)	1	86	2050	109	2250
22 h (+ 3 h)	1	88	2050	109	2300
23 h (+ 4 h)	1	90	2100	113	2300
24 h (+ 5 h)	1	91	2000	112	2350
<b>Composition B</b>					
<b>Procedure I</b>					
<b>Composition C</b>					
19 h at 25°C (overnight)	1	88	2050	102	2250
21 h (+ 2 h)	1	93	2000	109	2250
23 h (+ 4 h)	1	93	2000	113	2300
25 h (+ 6 h)	1	95	2050	108	2300
19 h at 25°C (overnight)	35	89	2050	98	2200
21 h (+ 2 h)	35	95	2100	104	2200
23 h (+ 4 h)	35	95	2000	105	2250
25 h (+ 6 h)	35	97	2050	111	2200

Table 8 - Results (continued)

Thawing/proofing	Storage time (days at -20°C)	Proof height (mm)	Loaf Volume (ml)	Proof height (mm)	Loaf Volume (ml)
Composition B					
Procedure II					
19 h at 2-4°C (overnight)	1	-	-	-	-
22 h (+ 3 h at 30°C)	1	103	2200	103	2200
23 h (+ 4 h at 30°C)	1	105	2200	105	2200
24 h (+ 5 h at 30°C)	1	104	2200	104	2200
25 h (+ 6 h at 30°C)	1	108	2250	108	2250

The baking results of the doughs of Table 8 show that the different thawing/proofing procedures do result in a constant bread quality with respect to the bread volume. The bread volume was hardly influenced by the point of time at which the fully proofed doughs were baked. Also the storage time in the freezer did not influence the bread volume. Even if yeast activity would have been partly lost during frozen storage of the dough, all fermentable sugars are still completely converted into CO<sub>2</sub> gas if proof times are long enough. Thus loaf volumes in this bake-off system were hardly affected by variations in the period of storing the frozen doughs in the freezer.

The fully proofed doughs could be kept for a long time (at least 6 hours) but not unlimited at 30°C.

The addition of lactose (composition B) gave the bread a somewhat sweeter taste (lactose is not

fermented by the yeast). Xanthan gum (composition B) was added to improve the crumb structure of bread in this bake-off system.

# Claims

- 5 1. A dough for the preparation of a yeast-leavened flour product which comprises yeast and sugar(s) fermentable by the yeast, characterized in that the amount of sugar(s) fermentable by the yeast is limited so that the maximal gas production by the yeast is controlled.
- 10 2. A dough according to claim 1 characterized in that at least part of the sugar(s) fermentable by the yeast originates from carbohydrates in the dough which are converted by enzymes in the dough during a bread making process into sugar(s) fermentable by the yeast.
- 15 3. A dough according to claim 1 or 2 characterized in that the amount of sugars fermentable by the yeast is 1-3 w/w% calculated on flour.
4. A dough according to any one of the preceding claims characterized in that it comprises a flour which contains less than 2% damaged starch.
- 20 5. A dough according to any one of the preceding claims which further comprises 0.1-10% of non-fermentable sugar(s), preferably lactose or whey permeate.
6. A dough according to any one of the preceding claims which further comprises 0.1-2% of xanthan gum.
- 25 7. A dough according to any one of the preceding claims characterized in that the yeast is not capable of fermenting at least one of maltose and saccharose.
8. A dough according to claim 7 characterized in that the yeast is a *Saccharomyces* or *Kluyveromyces*, preferably selected from *S. cerevisiae*, *S. unisporus*, *S. diarensis*, *S. exiguus* and *S. kluyveri*.
- 30 9. A method for producing a dough comprising yeast and sugar(s), characterized by limiting the amount of sugar(s) fermentable by the yeast so as to control the maximal gas production by the yeast.
10. A method according to claim 9 characterized by allowing the yeast to ferment substantially all available fermentable sugar(s) during the fermentation period of a bread making process.
- 35 11. A method according to claim 9 or 10 wherein the dough is as defined in any one of claims 1 to 8.
12. A method according to any one of claims 9 to 11 which includes carrying out a prefermentation step on a substantial part of the flour to reduce the amount of fermentable sugar in the dough.
- 40 13. A method according to any one of claims 9 to 12 characterized by adding carbohydrate to the dough as the sole source of sugar fermentable by the yeast.
- 45 14. A method according to any one of claims 9 to 13 which includes the step of freezing the dough.
15. A method according to claim 14 which comprises the steps of
  - (a) dividing the unfrozen dough into separate portions of dough,
  - (b) molding each portion of dough into the desired shape, and
  - 50 (c) freezing each portion of the dough to a temperature of -30 °C to -10 °C.
16. A method according to claim 15 which further includes the steps of
  - (a) thawing the frozen dough at a temperature of 2 to 50 °C,
  - (b) proofing the dough for at least 40 minutes at a temperature of 20 to 50 °C, and
  - 55 (c) baking the dough.
17. A method according to claim 16 which comprises combining the steps of thawing and proofing in one step by bringing the frozen dough to a temperature of 20 to 50 °C.



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## EUROPEAN SEARCH REPORT

Application Number

EP 91 20 0286

DOCUMENTS CONSIDERED TO BE RELEVANT					
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)		
X	GB-A-1 007 280 (AMERICAN MACHINE & FOUNDRY) * Claims; page 1, lines 83-87; page 2, lines 80-109; page 2, lines 50-61; page 3, lines 15-29 * - - -	1,2,5,6, 8-10	A 21 D 2/18 A 21 D 8/04		
X	DE-A-2 757 779 (LESAFFRE et CIE) * Example 4 * - - -	1-3			
X	DE-A-2 740 245 (PATENT TECHNOLOGY) * Page 10, paragraphs 1,3; table A; example 1; claims 1,4,6 * - - -	1-3,5			
X	DE-B-1 051 215 (BAKERS PROCESS CIE) * Claims; column 1, lines 46-54; column 3, lines 1-7; column 3, line 63 - column 4, line 4; column 5, lines 4-11 * - - -	1-3,5,8,9, 10			
X	THE BAKERS DIGEST, vol. 51, no. 5, October 1977, pages 81-86; P.L. FINNEY: "A review of older and some newer short-time bread baking studies" * Page 83, column 1, paragraphs 2,3; page 84, column 3, paragraph 3 * - - -	1-3,8,9			
A	DE-A-1 916 440 (FOREMOST-McKESSON) * Claims * - - -	12	TECHNICAL FIELDS SEARCHED (Int. Cl.5)		
A	EP-A-0 197 497 (ORIENTAL YEAST CO.) * Claims * - - -	1,7,8	A 21 D		
A	FR-A-2 590 42 (SOCIETE GENERALE DE PATISSERIE ARMORICAINE) - - - - -				
The present search report has been drawn up for all claims					
Place of search The Hague		Date of completion of search 23 April 91	Examiner COUCKE A.O.M.		
<table><tr><td><b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention</td><td>E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- &amp; : member of the same patent family, corresponding document</td></tr></table>				<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention	E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document
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